ATODP0100US **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of	:	
Feurhaupter et al	:	Group Art Unit: 1763
Serial No.: 10/675,019	:	Examiner: Roberts P. Culbert
Filed: September 30, 2003	:	Confirmation No. 4826

For: IMPROVED METHOD FOR MICRO-ROUGHENING TREATMENT OF COPPER AND MIXED-METAL CIRCUITRY

DECLARATION OF CRAIG V. BISHOP UNDER 37 C.F.R. 1.132

VIA EFS
M/S AMENDMENT
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, Craig V. Bishop, declare and say as follows:

(1) I am an employee of Atotech Deutschland GmbH ("Atotech"), the assignee of the above-identified application. At present, I am an R&D Group Leader at Atotech. I was previously employed by McGean-Rohco, Inc. ("McGean"). At McGean, I was Special Projects Director until 2001 when Atotech acquired much of McGean's intellectual property and I became an employee of Atotech. I have been employed by McGean and Atotech for a total of 18 years, as of September 1, 2006. I have been

employed in the area of surface engineering for over 30 years. I am a named inventor on at least 20 issued U.S. patents. I am the author of numerous publications and book contributions relating to the composition, structure and performance of modified surfaces, and have worked as an analyst developing methods of characterizing such surfaces. I worked for Lockheed Corp. as a Materials Test Department Manager at the NASA White Sands Facility from 1980 to 1988. My research has related to trivalent chromium passivation of zinc, aluminum and their alloys, coatings to reduce decomposition of space-storable liquid rocket propellants, thin film optical coating for high energy lasers, zinc alloy electroplating, improved adhesion for multilayer printed wiring boards, the role of anisotropism in electrodeposits, and recently lubrication methods to reduce wear in the boundary layer regime. My formal education includes B.S. degrees in biology and chemistry from Metropolitan State College, Denver, Colorado, and graduate level and continuing education courses in polymer science and materials science, at Cleveland State University, Cleveland, Ohio, and the Massachusetts Institute of Technology, respectively. For these reasons and with this background, I consider myself and believe I am considered by my colleagues to be a person of skill in the art of surface treatment and modification, particularly with respect to metal substrates and in the area of surface micro-roughening and intergranular etching of such substrates.

(2) The present application discloses and claims a process to improve the adhesion of dielectric materials to a metal layer, and includes a step of providing an unpatterned metal layer having a first major surface, in which the metal layer includes a layer of copper and a layer of a second metal or alloy. An example of this "mixed-metal" is copper-invar-copper, also known as CIC. The process further includes a step of micro-roughening the first major surface to form a micro-roughened surface. This micro-roughening removes some metal, roughening and preparing the surface for later

bonding to dielectric materials. The process further includes a step of etching the metal layer to form a circuit pattern in the metal layer and, in accordance with this process, the micro-roughening is carried out prior to the etching. This temporal relationship is important because, in a mixed-metal, if the micro-roughening is carried out subsequent to the circuit pattern-forming etching step, due to galvanic edge effects arising from the two different metals in close proximity to each other, the entire surface may not be micro-roughened, thereby resulting in inferior adhesion to the subsequently applied dielectric materials. That is, the galvanic edge effect, discovered by the present inventors and addressed by this invention, would result in little or no roughening of the surface of the circuit pattern formed from a mixed-metal substrate. In accordance with one embodiment of the process, the micro-roughening is carried out by applying a mixture comprising water, acid, an oxidant and a corrosion inhibitor to the unpatterned metal layer. This combination results in effective micro-roughening of the surface. In this process, from about 0.5 to about 2 microns of metal is removed from the first major surface in the micro-roughening step. That is, in the present inventive process, a small but significant amount of metal is actually and deliberately removed from the surface of the metal in the micro-roughening step.

(3) It is my understanding that the claims of the present application have been rejected over various combinations of prior art. Based on the understanding I have obtained from my review, in the following I discuss the prior art references, U.S. Patent No. 6,500,349 B2, to Andresakis et al. (referred to below as "Andresakis"), U.S. Patent No. 6,261,466 B1, to Bayes et al. ("Bayes"), and U.S. Published Application No. 2002/0029730, to Lee et al. ("Lee"), and the reasons why the claims of the patent result in a different product from that which would be obtained by the combination of these references.

(4) It is my understanding that the Examiner has contended, in the Office actions in this application, (1) that Andresakis teaches a process of improving adhesion of a dielectric material to a metal layer, including micro-roughening the surface of an unpatterned metal layer prior to etching the metal layer to form a circuit pattern, (2) that it would have been obvious to apply the method taught by Andresakis to a CIC metal such as that taught by Lee, (3) that although Andresakis teaches a black oxide adhesion promoting and does not disclose or suggest the use of water, acid, oxidant and corrosion inhibitor to carry out such adhesion promotion, (4) that Bayes does teach such ingredients, and (5) that Bayes further teaches that such ingredients may be used as a substitute for black oxide adhesion-promoting treatments. I have carefully reviewed all of the references cited by the Examiner, and provide the following discussion of them and the product that would be obtained by use of the processes disclosed by these references, as compared to the product obtained by use of the process of the present application.

(5) Andresakis teaches the use of a black oxide to improve adhesion of the metal substrate to subsequently applied dielectric materials. Andresakis discloses, at column 4, lines 44-59, the following:

> The foil's shiny side, matte side, or both, may optionally be pre-treated with a bond enhancing treatment known in the art, which may serve as an adhesion promoter for the copper foil. One preferred bond enhancing treatment includes Durabond, a tin oxide, which can be purchased commercially from McGean Rohco Inc. of Cleveland, Ohio. Other suitable bond enhancing treatments also nonexclusively include oxide treatments. One preferred oxide treatment is black oxide treatment, which oxidizes the copper foil with an oxidant thereby to convert the copper on the substrate to spiny copper oxide. Black oxide treatment preferably uses, as a treating solution, a solution of an oxidant such as sodium hypochlorite.

the copper metal substrate to convert it to spiny copper oxide. As is well known in the art, the black oxide treatment does not remove more than inadvertent amounts of copper from the treated surface. While there may be some small amount of copper removed, the goal and actual result is that black copper oxide is formed on the surface of the copper metal substrate in the black oxide process taught by Andresakis, and no more than an inadvertent amount of metal is removed from the oxidized surface. Furthermore, even though Andresakis discloses roughening a metal surface followed by circuit pattern formation, Andresakis fails to recognize that any problem would result from the application of such process to a mixed-metal substrate.

(6) As stated by the Examiner, Bayes teaches an adhesion promotion composition including all of hydrogen peroxide, an inorganic acid, an amine or quaternary ammonium compound, and one or more organic corrosion inhibitors (column 4, lines 63-67). Bayes teaches that "use of the composition results in the formation of a roughened conversion coated surface believed to be composed of an insoluble complex of copper" (col. 5, lines 1-3). As stated by the Examiner, the Bayes "process can be used to replace the black copper oxide adhesion promotion step in a considerably reduced number of steps." As would be understood by anyone of ordinary skill in the art, the process of Bayes forms a copper oxide on the surface of the copper metal substrate. Bayes refers to the "conversion coating" formed by the disclosed process. As is known in the art, a conversion coating is a coating formed by conversion of the substrate metal surface to a derivative compound, normally an oxide compound, but does not include metal removal. The purpose of a conversion coating is to convert the pre-existing surface, not to remove it. Thus, like Andresakis, Bayes teaches the formation of an oxide coating, which does not include the removal of metal from the surface.

to convert the pre-existing surface, not to remove it. Thus, like Andresakis, Bayes teaches the formation of an oxide coating, which does not include the removal of metal from the surface.

(7) It appears that Bayes actually teaches away from removal of metal by etching the metal surface. At column 1, lines 39-61, Bayes discusses various oxide and other treatments used to enhance adhesion between the circuit layer and the overlying dielectric resin layers. At lines 57-61, Bayes states: "Metal surfaces that have been microetched, but not conversion coated do not generally possess as high a degree of surface roughness and texture, as can be inferred from their greater reflection of visible light." It is my understanding, from this passage, that Bayes is teaching that formation of an oxide on the surface is to be sought and that roughening the surface by etching away metal from the surface (as happens with the micro-roughening of the present invention) is to be avoided, and thus would be understood not to recommend, that is, to teach away from, such metal removal as by micro-roughening.

(8) As contended by the Examiner, Lee teaches mixed-metals such as CIC, and teaches advantages to use of them. However, like Andresakis, Lee fails to recognize the problem discovered and solved by the present invention, i.e., that when a circuit pattern is formed in a mixed-metal, and the circuit pattern is subsequently treated to increase its roughness, that a galvanic edge effect can result in little or no actual roughening of the surface sought to be roughened. Thus, even though Lee et al. would appear to suggest the use of mixed-metal substrates for use in a process such as that disclosed by Andresakis, both Lee and Andresakis fail to recognize that any problem, and particularly not a galvanic edge effect, would result from the application of a process such as that of Andresakis, with or without the allegedly obvious modification to use the composition of Bayes, to the mixed-metal substrate of Lee.

(9) Thus, in summary, the combination of prior art references, Andresakis, Bayes and Lee, cited and relied upon by the Examiner in rejecting the claims of the present application do not remove any more than inadvertent amounts of metal from the surface of the metal substrate. In addition, Andresakis, Bayes and Lee all fail to recognize the problem recognized and addressed by the present invention.

I, Craig V. Bishop, hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued therefrom.

Respectfully submitted,

Craig V. Bishop

Sept. 15, 2006

Date

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